



## Preventive Veterinary Medicine

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## Investigating preventive-medicine consultations in first-opinion small-animal practice in the United Kingdom using direct observation

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## ABSTRACT

Preventive-medicine consultations account for a large proportion of the veterinary caseload and previous research has suggested these consultations are fundamentally different from those in which the animal is presented for a specific health problem. There has been recent controversy around some aspects of preventive medicine for cats and dogs, and the full health benefits of the preventive-medicine consultation remain unclear. The aim of this study was to compare characteristics of the consultation and the problems discussed during the consultation between preventive-medicine consultations and other types of consultations.

Data were gathered during direct observation of small-animal consultations in seven first-opinion practices in the United Kingdom. Data collected included type of clinical examination performed, patient signalment, and details of all problems discussed (including whether the problem was presenting or non-presenting, new or pre-existing, who had raised the problem, body system affected and whether an action was taken). A two-level multivariable logistic-regression model was developed, with canine and feline patients at Level 1 nested within consulting veterinary surgeons at Level 2, and a binary outcome variable of preventive-medicine consultation versus specific health-problem consultation.

A total of 1807 patients were presented, of which 690 (38.2%) presented for a preventive-medicine consultation. Dogs were the most frequently presented species ( $n = 1168$ ; 64.6%) followed by cats ( $n = 510$ ; 28.2%), rabbits ( $n = 86$ ; 4.8%) and patients of other species ( $n = 43$ ; 2.4%). The five variables remaining in the multi-level model were whether multiple patients were presented, patient age, clinical examination type, weighing and number of problems discussed. Species, breed, sex, neutering status and practice did not remain in the final model.

Many non-presenting problems, including both preventive-medicine problems and specific-health problems, were discussed and acted upon during all types of consultations. Dental and behavioural non-presenting problems were discussed more frequently during preventive-medicine consultations compared with specific health-problem consultations.

Preventive-medicine consultations represent an opportunity for veterinary surgeons to discuss other aspects of preventive medicine, and to detect and manage new and ongoing health problems. A greater evidence base is needed to understand whether detecting and managing underlying disease during the preventive-medicine consultation has a positive impact on lifelong patient health and welfare.

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## 1. Introduction

First-opinion veterinary practices are a valuable source of clinically relevant data and in recent years, research has increasingly focused on harnessing these data (Lund, 2015). However most

of these studies have excluded preventive-medicine consultations from the data collected altogether (Radford et al., 2011) or have focused primarily on specific health problems such as canine diabetes mellitus (Mattin et al., 2014) and feline hyperthyroidism (Stephens et al., 2014). Preventive medicine is one of the most common aspects of veterinary medicine discussed during the first-opinion small-animal consultation (Hill et al., 2006), therefore, examining preventive-medicine consultations in depth may lead to findings which are highly valuable in first-opinion practice.

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Previous research has suggested that the preventive-medicine consultation may be fundamentally different to consultations for a specific health problem in terms of number of problems discussed (Robinson et al., 2015a), clinical examination (Robinson et al., 2015b), and communication style and content (Shaw et al., 2008). Recently, there has been controversy surrounding some aspects of preventive medicine, particularly vaccination (Day et al., 2010) and routine neutering (Beauvais et al., 2012). The interval between booster vaccinations has been extended for some antigens, but remains controversial, with various expert groups disagreeing on the recommended inter-vaccination interval for certain pathogens (Day et al., 2010; Scherk et al., 2013; AAHA, 2015; ABCD, 2015).

The potential role of the preventive-medicine consultation in addressing other aspects of patient health and welfare has not yet been fully addressed. Banyard (1998) found that 52% of cats and dogs presented for vaccination were suffering from concurrent disease, while Roshier and McBride (2013) found behavioural problems were often discussed during canine annual booster consultations. Therefore, it may be that even if the vaccination interval were to be increased, an annual health check to ensure concurrent disease is detected in a timely manner may still be advisable (Day et al., 2010). Understanding the health benefits of the preventive-medicine consultation, aside from the value of the preventive treatment for which the patient has been presented, is vital to determining whether such an annual health check would potentially be beneficial for the patient.

Gathering detailed data on all aspects of the consultation requires a method which is able to capture the full complexity of these encounters. In human medicine, this complexity is well recognised and previous research has used real-time direct observation of consultations as a method of data collection (Flocke et al., 2001). In contrast, studies on caseload in first-opinion veterinary practice have focused predominantly on remote data collection via the electronic patient record, and the alternative option of real-time direct observation of consultations has only recently been explored (Lund, 2015).

The primary aim of this study was to explore the differences between preventive-medicine consultations and other types of consultations, in terms of characteristics of the consultation and patient signalment. The secondary aim was to compare problems discussed in addition to the presenting problem between preventive-medicine consultations and other types of consultations, in terms of type of problems, who initially raised the problem, body system affected, and action taken. In addition, an inter-rater reliability study was conducted to measure agreement between two observers for all variables measured.

## 2. Materials and methods

### 2.1. Practice selection

A convenience sample of seven first-opinion veterinary practices in the UK, all of which undertook preventive-medicine consultations, was recruited (Robinson et al., 2015a). Practices recruited were those involved in a previous study (Dean et al., 2013), or those who had expressed interest in working with the Centre for Evidence-based Veterinary Medicine (CEVM). All seven practices approached agreed to take part in the study and no practices declined. Seven practices in total were chosen as this was considered to be the maximum number of practices which could feasibly be included using the methods selected. Six practices were located in England (three in the Midlands and three in the South) and one practice was located in Scotland. Four practices saw small animals only, while three practices also saw farm and equine patients. Two practices were single branch only, while

five practices had two or more branches. The median number of veterinary surgeons carrying out small-animal consultations per practice was 8 (range 3–20). The median years qualified of all veterinary surgeons observed was 14.3 (range 1–40 years). Of the 60 veterinary surgeons observed, 12 (20.0%) were certificate holders. Further details on the sample of practices involved in the study are reported in Robinson (2014).

### 2.2. Data-collection tool

#### 2.2.1. Development of the tool

A data-collection tool was developed to allow the collection of complex data by a researcher during real-time direct observation of small-animal consultations at participating practices. The tool consisted of a series of open and closed questions on a paper form which was constructed using specialised questionnaire software (Cardiff Teleform® Version 10.5.1, Verity Inc., Cambridge) for ease of data entry and processing. The tool was used to gather data on signalment of the animal(s) presented, clinical examination performed, problems discussed, body system(s) affected, and actions taken. Following initial development of the tool, pre-test and pilot studies were conducted between August 2010 and March 2011, to help identify any issues relating to design of the data-collection tool or feasibility of data collection. Pre-testing involved collection of data by the primary investigator (NR) and another author (RD), during a single morning each at two of the practices, in August 2010. A pilot study was then conducted between September 2010 and March 2011, with data collected by the primary investigator during a single day at each of the seven practices. The reliability of the tool (Petrie and Sabin, 2009) was tested in May 2012 at one sentinel practice and involved the primary researcher and another author (MB) observing the same series of consultations. The two datasets were collated and sorted by a third researcher (RD). Agreement was then assessed by comparing each variable recorded in each consultation between the two datasets. Development, testing and utilisation of the data-collection tool has been described in more detail previously (Robinson et al., 2015a).

#### 2.2.2. Data collected

A separate copy of the data-collection tool was completed for each patient presented. Data were collected on all problems discussed during the consultation, with a problem defined as 'any two-way discussion between owner/carer and vet regarding any aspect of the patients health and wellbeing' to include issues relating to preventive medicine as well as to specific health problems. The reason for presentation as stated by the owner/veterinary surgeon (or the first problem mentioned where it was not explicit), was considered to be the 'presenting problem'. Each additional problem discussed after this was considered to be a 'non-presenting problem'. For each patient, only one presenting problem could be recorded; however, several non-presenting problems could be recorded.

**2.2.2.1. Characteristics of the consultation and patient signalment between preventive medicine and specific health-problem consultations.** For each patient presented, data were collected on patient signalment, including species, breed (pedigree or crossbreed), age, sex and neutering status. Data were also gathered on aspects of the consultation for each patient, including practice, consulting veterinary surgeon, whether multiple patients were presented, whether a full or focused clinical examination was performed, and whether the patient was weighed. For each patient, the consultation was also categorised as being a preventive-medicine consultation or a specific health-problem consultation. The consultation was categorised as a preventive-medicine consultation if the presenting problem related to the prevention of disease or injury, and the type

of preventive medicine was recorded. Types of preventive medicine included: vaccination; rabies serology; microchipping; neutering advice; nail clipping; parasite prevention; admit for or discharge following prophylactic surgery; prevention of pregnancy or season (estrus); any other routine health check, for example routine new animal or puppy/kitten checks. The consultation was categorised as a specific health-problem consultation if the presenting problem related to a disease, injury, or set of clinical signs which was currently affecting the animal.

**2.2.2.2. Characteristics of non-presenting problems.** As with presenting problems, each non-presenting problem was categorised as either a preventive-medicine problem or a specific health problem. Therefore, each patient could potentially have one or more non-presenting problems, which could be preventive medicine or specific health problems, regardless of the type of consultation. The initial data-collection tool included sufficient space to allow collection of data on up to four problems per patient, however during the pilot study, between five and eight problems were discussed for several patients. As a result, the final data-collection tool allowed for the collection of up to eight problems per patient.

Data recorded for non-presenting specific health problems included whether the problem was new or pre-existing, whether it was initially raised by the veterinary surgeon or owner, the body system affected and whether it resulted in an action. Definitions were developed for each variable to ensure consistency of coding (Supplementary Appendix 1). New problems were defined as problems for which the patient had not been presented to the veterinary surgeon in the past 12 months. Pre-existing problems were defined as problems for which the patient had presented in the past 12 months, including both ongoing problems and previously-resolved problems which had recurred. This could usually be ascertained by direct observation of the consultation alone, however where there was uncertainty the clinical records were checked following the consultation. Action was defined as one or more of the following: therapeutic- or prophylactic-treatment prescribed; management-advice given; diagnostic work-up performed; referral; euthanasia. A problem was considered to have resulted in no action if none of the above actions were taken or if the advice given was to monitor the problem only. Further information as to how these data were categorised are detailed in previous manuscripts (Robinson, 2014; Robinson et al., 2015a,c).

Data recorded for non-presenting preventive-medicine problems included type of preventive medicine and whether an action was taken.

### 2.3. Data collection

Data were collected during two separate one-week periods at each of the seven sentinel practices. The data-collection weeks were arranged at the convenience of the participating practices, and took place between April 2011 and June 2012. During these weeks, the primary investigator observed consultations by a number of different veterinary surgeons during regular weekday consulting hours. Where multiple veterinary surgeons were consulting simultaneously, selection of consultation stream to observe was based on convenience and feasibility (e.g. consultation room size), however an effort was made to ensure some time was spent observing each veterinary surgeon during the data-collection period. Where the same patient was presented more than once during the data collection period, only data from the first consultation in which the observing researcher was present were included in the analyses.

### 2.4. Statistical analysis

Descriptive statistics were carried out using IBM® SPSS® Statistics 22. Statistical significance was initially set at 0.05, with a Bonferroni correction (for the secondary aim) applied to account for multiple comparisons between type of consultation (preventive-medicine consultation or specific health-problem consultation) and various other variables (Petrie and Sabin, 2009).

#### 2.4.1. Characteristics of the consultation and patient signalment between preventive medicine and specific health-problem consultations

A two-level multivariable logistic-regression model was used to investigate the differences in patient and consultation characteristics between preventive-medicine consultations and specific health-problem consultations, taking into account clustering of patients within consulting veterinary surgeon. Only data collected for dogs and cats were included in the model. A binary outcome variable for consultation type was used, with preventive-medicine consultations coded as 1, specific health-problem consultations coded as 0. The model was developed in MLwiN version 2.10 with patient (Level 1) nested within consulting veterinary surgeon (Level 2). Due to the small number of practices, practice could not be included as a third level and was instead added into the model as an explanatory variable at Level 2. The model took the form:

$$\text{Preventive-medicine consultation}_{ij} \sim \text{Binomial}(n_{ij}, \pi_{ij})$$

$$\text{logit}(\pi_{ij}) = \beta_{0j} + \beta_1 x_{1ij} + \beta_2 x_{2ij} + \beta_3 x_{3ij} + \beta_4 x_{4ij} \dots + \beta_k x_{kij}$$

$$\beta_{0j} = \beta_0 + u_{0j}$$

where  $i$  and  $j$  represent the  $i$ th patient presented to the  $j$ th veterinary surgeon.  $\beta_0$  is the overall intercept and  $\beta_{0j}$  the intercept for the  $j$ th veterinary surgeon.  $\beta_1 x_{1ij}$ ,  $\beta_2 x_{2ij}$  and so on are explanatory variables and their associated coefficients, including practice, which was not modelled as a separate level due to the small number of practices involved in the study.

Variables added into the model consisted of characteristics of the consultation and aspects of patient signalment. All variables added into the model were categorical with the exception of patient age, which was centred around the grand mean upon addition to the model. The Box–Tidwell test was conducted to test the assumption that the logit of the outcome variable had a linear relationship to patient age (Hosmer and Lemeshow, 1989). An interaction term between patient age and its natural log was added to the model and examined for significance, which would suggest a non-linear relationship. Problem number was added as a categorical variable, with categories consisting of 1 problem, 2 problems, 3 problems, and 4 or more problems, to avoid making assumptions about linearity. Cross-tabulations were performed for all explanatory variables prior to building the model, and examined for evidence of strong collinearity between any of the explanatory variables. Forward selection was initially used to build the model, with variables added one at a time. Iterative generalised least squares (IGLS) were used for initial parameter estimates with significance calculated using the Wald test (Hox, 2010). Markov-chain Monte Carlo (MCMC) simulations with 50,000 iterations and a burn-in length of 5,000 were then used for final parameter estimates, using IGLS estimates as starting values and with diffuse prior distributions specified for model parameters. MCMC estimation was used because it produces more reliable estimates (Browne and Draper, 2006) particularly where there are smaller sample sizes within level 2 units (i.e. where only a small number of consultations were recorded for some veterinary surgeons). Deviance information criterion (DIC) was used as a measure of goodness-of-fit, with decreasing DIC represent-

ing improved model fit, and therefore the final model selected was that with the lowest DIC. Random-intercept models were fitted first then random-slope models examined for each variable. All possible two-way interaction terms were evaluated, regardless of whether the main effects were themselves significant in the model. Any main effects which were involved in significant interactions would be retained in the model. Variance at consulting-veterinary-surgeon level (Level 2) was estimated using the latent-variable approach (Goldstein et al., 2002).

#### 2.4.2. Characteristics of non-presenting problems

Chi-square tests (with Bonferroni correction) were used to compare categorical variables, for example body system affected, for non-presenting problems discussed during the two different types of consultation.

#### 2.4.3. Inter-rater reliability

Cohen's Kappa was calculated using IBM® SPSS® Statistics 22 to measure agreement in categorical variables between the two researchers during the inter-rater reliability study. Kappa takes a value from -1, which implies perfect disagreement, to 1, which implies perfect agreement. Kappa values above 0.6 are considered substantial, while those above 0.8 are considered almost perfect (Petrie and Sabin 2009). Linear-weighted Kappa was calculated for problem number, and Intraclass Correlation (using a two-way random model with measures of absolute agreement) was calculated for patient age.

#### 2.5. Ethical approval

Approval was obtained from the ethics committee at the School of Veterinary Medicine and Science, The University of Nottingham for the collection of data through direct observation, and subsequent analysis of this data. Details of how informed consent was obtained and the data anonymised have been detailed in a previous manuscript (Robinson et al., 2015a).

### 3. Results

One client opted out of the study during the pilot study (for reasons unknown) and no clients opted out during the main data-collection period. The median number of consultations observed per practice during the total data-collection period was 290 (Range 85–321). In total, 60 different veterinary surgeons were observed across the seven practices, with a median of 22 consultations observed per veterinary surgeon (Range 1–197).

#### 3.1. Characteristics of the consultation and patient signalment between preventive medicine and specific health-problem consultations

A total of 1807 patients were presented over 14 weeks of data collection consisting of 64.6% ( $n=1168$ ) dogs, 28.2% ( $n=510$ ) cats, 4.8% ( $n=86$ ) rabbits, and 2.4% ( $n=43$ ) patients of other species. Of these 1807 patients, 690 (38.2%) were presented for a preventive-medicine consultation and 1117 (61.8%) for a specific health-problem consultation. The most common reason for presentation in preventive-medicine consultations was vaccination, followed by routine check/advice then clip nails (Table 1).

The Bonferroni correction resulted in a new significance level of  $p=0.003$ . Consultation and patient characteristics in the two different types of consultation are shown in Table 2.

Data for 1678 patients in total (1168 dogs and 510 cats) were included in the multi-level model. There was no evidence of any strong collinearity between the any of the explanatory variables, including those subsequently excluded from the final model. No

**Table 1**

The presenting problems discussed for the 690 patients presented for preventive-medicine consultations during direct observation in seven practices. Data were gathered by real-time direct observation of 690 preventive-medicine consultations in seven UK practices between April 2011 and June 2012.

Reason for presentation	<i>n</i>	%
Vaccination	572	82.9
Routine check/advice	68	9.9
Clip nails	12	1.7
Admit for prophylactic surgery	11	1.6
Rabies serology	10	1.4
Discharge after prophylactic surgery	8	1.2
Parasite prevention	3	0.4
Prevention of season	3	0.4
Prevention of pregnancy	2	0.3
Microchip placement	1	0.1
Total	690	100.0

random slopes or interaction terms were retained within the model. The interaction term between patient age and its natural log was not significant when added to the model, so the assumption of linearity was not violated. The five explanatory variables remaining in the final model were whether multiple animals were presented, age of the animal, type of clinical examination, whether the animal was weighed, and number of problems discussed. Explanatory variables which did not remain in the final model were species, breed (pedigree versus crossbreed), sex, neuter status and practice.

Preventive-medicine consultations were associated with the presentation of multiple patients and younger patients, as well as the conducting of full clinical examinations and weighing, compared with specific health-problem consultations (Table 3). Preventive-medicine consultations were also associated with discussion of a greater number of problems even when accounting for other patient and consultation characteristics. The proportion of unexplained variance remaining at the veterinary-surgeon level (Level 2) in the final model was 13.05%.

#### 3.2. Characteristics of non-presenting problems

The breakdown of all problems discussed during the two different types of consultation is shown in Fig. 1. This section will focus on the non-presenting problems discussed during preventive-medicine consultations ( $n=1390$ ) and specific health-problem consultations ( $n=1113$ ) i.e., problems which were not the reason for presentation. Significantly more non-presenting preventive-medicine problems and non-presenting specific health problems were discussed per patient during preventive-medicine consultations than during specific health-problem consultations (both  $p<0.001$ ).

##### 3.2.1. Non-presenting preventive-medicine problems

In total, 57.4% ( $n=396/690$ ) of patients presenting for a preventive-medicine consultation had at least one non-presenting preventive-medicine problem discussed, compared with 10.4% ( $n=116/1117$ ) of patients presenting for specific health problem. Parasite prevention was the most common non-presenting preventive-medicine problem discussed during preventive-medicine consultations, while vaccination was the most common non-presenting preventive-medicine problem discussed during specific health-problem consultations (Table 4). An action was taken for 79.9% ( $n=357/447$ ) of non-presenting preventive-medicine problems discussed in preventive-medicine consultations, and 90.2% ( $n=129/143$ ) of non-presenting problems discussed during specific health-problem consultations.



**Table 2**

Consultation and patient characteristics for patients presented for preventive-medicine consultations compared with specific health-problem consultations. Data were gathered by real-time direct observation of 1807 small-animal consultations in seven UK practices between April 2011 and June 2012.

Variable	Categories	Type of consultation			
		Preventive medicine		Specific health problem	
		<i>n</i>	%	<i>n</i>	%
Multiple animals	Yes	116	16.8	32	2.9
	No	574	83.2	1085	97.1
	Total	690	100.0	1117	100.0
Type of clinical examination	None	38	5.5	108	9.8
	Focused	49	7.1	504	45.6
	Full	603	87.4	494	44.7
	Total	690	100.0	1106 <sup>a</sup>	100.0
Weighing	No	282	40.9	655	59.2
	Yes	408	59.1	451	40.8
	Total	690	100.0	1106 <sup>a</sup>	100.0
Species	Dog	444	64.3	724	64.8
	Cat	196	28.4	314	28.1
	Rabbit	40	5.8	46	4.1
	Other	10	1.4	33	3.0
	Total	690	100.0	1117	100.0
Breed	Pedigree	396	60.2	658	62.7
	Crossbreed	262	39.8	391	37.3
	Total	658 <sup>a</sup>	100.0	1049 <sup>a</sup>	100.0
Sex	Male	322	48.7	539	50.6
	Female	339	51.3	526	49.4
	Total	661 <sup>a</sup>	100.0	1065 <sup>a</sup>	100.0
Neutering status	Entire	311	47.0	434	40.8
	Neutered	350	53.0	631	59.2
	Total	661 <sup>a</sup>	100.0	1065 <sup>a</sup>	100.0

<sup>a</sup> Data are not shown for all 690 preventive-medicine consultations or 1117 specific health-problem consultations as data were missing for some patients.

**Table 3**

Explanatory variables remaining in the final two-level logistic-regression model, which included data from 1678 dogs and cats presented during real-time direct observation of veterinary consultations between April 2011 and June 2012. The outcome variable for the model was binary with preventive-medicine consultations coded as 1 and specific health-problem consultations coded as 0.

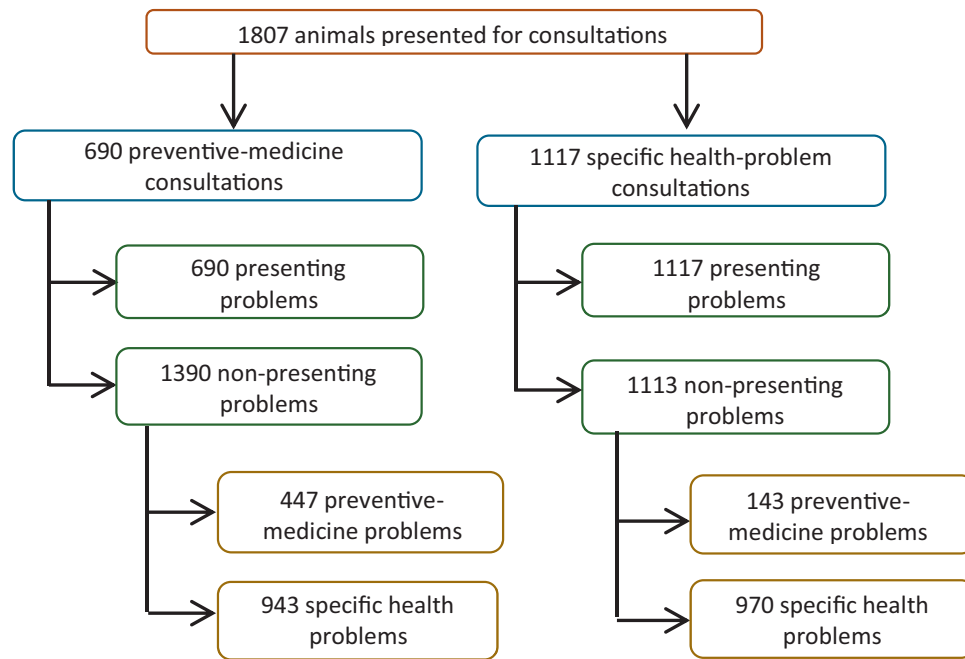
Parameter	Median	95% Credible interval		Odds ratio
		Lower	Upper	
Intercept ( $B_0$ )	–2.814	–3.547	–2.132	–
Multiple animals	No	Reference	–	–
	Yes	2.505	2.988	12.244
Age (gm) <sup>a</sup>	–0.193	–0.228	–0.159	0.824
Clinical Examination	None	Reference	–	–
	Focused	–2.474	–1.619	0.084
	Full	0.928	1.62	2.529
Weighing	No	Reference	–	–
	Yes	0.338	0.659	1.402
Problem number	1	Reference	–	–
	2	0.88	1.333	2.411
	3	1.664	2.148	5.28
	4 Plus	2.743	3.27	15.534

<sup>a</sup> Age of the patient presented was centred around the grand mean (more meaningful than being centred around an age of 0).

**Table 4**

Non-presenting preventive-medicine problems discussed for 690 patients presenting for preventive-medicine consultations ( $n = 447$  problems) and 1117 patients presenting for specific health-problem consultations ( $n = 143$  problems). Data were gathered by real-time direct observation of small-animal consultations in seven UK practices between April 2011 and June 2012.

Aspect of preventive medicine	Type of consultation			
	Preventive medicine		Specific health problem	
	<i>n</i>	%	<i>n</i>	%
Parasite prevention	351	78.5	46	32.2
Clip nails	50	11.2	29	20.3
Microchip	19	4.3	3	2.1
Neutering advice	17	3.8	8	5.6
Routine health check	6	1.3	3	2.1
Vaccination	4	0.9	54	37.8
Total	447	100.0	143	100.0



**Fig. 1.** Flow chart showing the breakdown of the number of problems discussed during preventive-medicine consultations and specific health-problem consultations. Data were gathered by real-time direct observation of 1807 small-animal consultations in seven UK practices between April 2011 and June 2012. See Supplementary Appendix 1 for definitions.

**Table 5**  
Characteristics of non-presenting specific health problems discussed during 690 preventive-medicine consultations ( $n=943$  problems) compared with 1117 specific health-problem consultations ( $n=970$  problems). Results shown are from chi-square analysis. Data were gathered by real-time direct observation of 1807 small-animal consultations in seven UK practices between April 2011 and June 2012.

		Type of consultation				
Variable	Categories	Preventive medicine		Specific health problem		p (chi-square)
		n	%	n	%	
Problem summary	New problem	633	67.1	519	53.5	<0.001 <sup>a</sup>
	Pre-existing problem	310	32.9	451	46.5	
	Total	943	100.0	970	100.0	
Raised by	Owner	567	60.1	649	66.9	0.002 <sup>a</sup>
	Veterinary surgeon	376	39.9	321	33.1	
	Total	943	100.0	970	100.0	
Action taken	Action	542	57.5	539	55.6	0.400
	No action	401	42.5	431	44.4	
	Total	943	100.0	970	100.0	

<sup>a</sup>  $p$  values remaining statistically significant after Bonferroni correction of the significance level to 0.003.

### 3.2.2. Non-presenting specific health problems

In total, 71.2% ( $n=491/690$ ) of patients presenting for a preventive-medicine consultation had at least one non-presenting specific health problem discussed, compared with 50.5% ( $n=564/1117$ ) of patients presenting for specific health problem. Significantly more new problems were discussed ( $p<0.001$ ) and significantly more problems were raised by the veterinary surgeon ( $p=0.002$ ) during preventive-medicine consultations than during specific health-problem consultations (Table 5). Over half of the non-presenting specific health problems discussed resulted in an action being taken, regardless of the type of consultation (Table 5).

Body system affected for problems discussed during preventive-medicine consultations was significantly different to body system affected for problems discussed during specific health-problem consultations ( $p<0.001$ ). Dental and behavioural problems were discussed more frequently in preventive-medicine consultations compared with specific health-problem consultations. Neurological problems were discussed less frequently in preventive medicine compared with specific health-problem consultations (Fig. 2).

### 3.3. Inter-rater reliability study

Data were recorded from 9 consultations all conducted by the same veterinary surgeon. The primary researcher (NR) recorded a total of 23 problems, while the additional researcher (MB) recorded 24 problems. Agreement between fields was therefore assessed as a proportion of all 9 animals or all 23 problems recorded by both researchers as appropriate (Table 6). Agreement was almost perfect or substantial for all patient and consultation characteristics, however agreement was generally poorer for problem characteristics, which generally required use of a series of definitions to categorise each problem.

## 4. Discussion

Preventive-medicine consultations account for a considerable proportion of first-opinion small-animal consultations. These consultations appear to be different from those for a specific health problem and often involve the discussion of multiple problems,

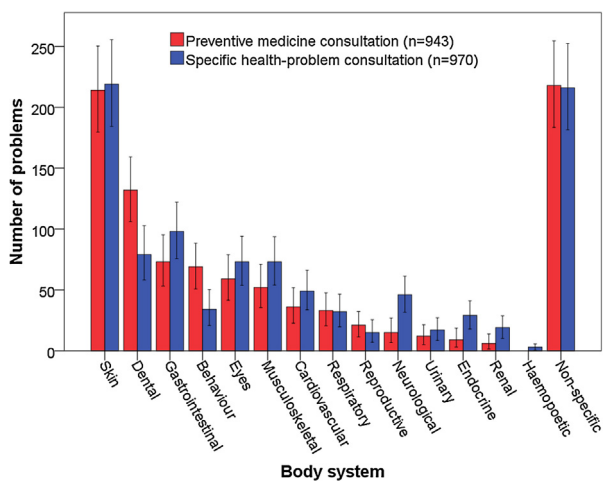
**Table 6**

Inter-rater reliability study comparing information recorded during real-time direct observation of nine first-opinion small-animal consultations in which 23 problems were discussed during May 2012.

Field	No. times recorded	Agree		Disagree		Kappa (95% CI)
		n	%	n	%	
Type of consultation <sup>a</sup>	9	8	88.9	1	11.1	0.769 (0.343–1.000)
Species	9	9	100.0	0	0.0	1.000 (1.000–1.000)
Breed	9	8	88.9	1	11.1	0.857 (0.595–1.000)
Age	9	8	88.9	1	11.1	0.994 (0.973–0.999)
Sex/Neutering	9	9	100.0	0	0.0	1.000 (1.000–1.000)
Clinical exam type	9	9	100.0	0	0.0	1.000 (1.000–1.000)
Weight	9	8	88.9	1	11.1	0.781 (0.375–1.000)
Problem number	9	6	66.7	3	33.3	0.781 (0.574–0.987)
Raised by <sup>b</sup>	23	11	47.8	12	52.2	0.018 (0.000–0.402)
Body system	23	17	73.9	6	26.1	0.655 (0.418–0.892)
Action	23	15	65.2	8	34.8	0.652 (0.341–0.962)

<sup>a</sup> Preventive-medicine or specific health-problem consultation.

<sup>b</sup> For 'Raised by' there were three possible options, veterinary surgeon, owner and prompt (by a vaccination or flea/worming treatment reminder). The majority of disagreement occurred around the use of the prompt category. This is not shown in Table 5 as this category applies only to preventive medicine problems.



**Fig. 2.** The proportion of non-presenting specific health problems affecting each body system, which were discussed during preventive-medicine consultations and specific health-problem consultations. Data were gathered by real-time direct observation of 1807 small-animal consultations in seven UK practices between April 2011 and June 2012. Error bars represent 99.7% confidence intervals (consistent with a Bonferroni-corrected *p* value of 0.003).

many of which lead to an action being taken. This is the first time that small-animal preventive-medicine consultations have been examined in detail.

A greater evidence base is needed to support veterinary decision-making during preventive-medicine consultations, because these consultations form a large part of the veterinary caseload and are fundamentally different to other types of consultation. Previous research has suggested that preventive-medicine consultations are often less hurried than those for a specific health problem, with more of a focus on lifestyle aspects of health (Shaw et al., 2008). Findings from the current study further highlight the differences between preventive-medicine consultations and specific health-problem consultations in terms of the patients presented, characteristics of the consultation, and the problems discussed. The patients presented during preventive-medicine consultations are often young animals, potentially presenting to the veterinary surgeon for the first time, and so these consultations may be an important opportunity to examine patients who may not be presented for other reasons until later in life. The frequent weighing and full clinical examinations which take place during these consultations could have an important role in the detection and management of underlying disease. Full clinical examinations occur less frequently in specific health-problem consultations. It is

currently unclear why this is the case, but it may be that a full examination is not appropriate or practical depending upon the nature of the presenting problem.

Preventive-medicine consultations appear to be even more complex than consultations for a specific health problem, with multiple problems frequently discussed. Some of these problems, for example dental problems, behavioural problems, and preventive-medicine problems, appear to be discussed less frequently in specific health-problem consultations, suggesting preventive-medicine consultations may be an opportunity to discuss problems which may not otherwise be addressed. The greater number of new problems discussed, many of which were raised by the veterinary surgeon, could reflect the usefulness of the full clinical examination in the early detection of disease during these consultations. Although the results highlight the complexity of the preventive-medicine consultation, previous research has suggested they are not significantly longer than specific health-problem consultations (Robinson et al., 2014). Allowing a longer appointment time for these consultations may allow more non-presenting problems to be raised and discussed more thoroughly. The use of a standard ten-minute appointment by many practices may mean that the role of the preventive-medicine consultation in addressing other aspects of patient health may still be falling short of its full potential. In the current study, discussions about parasite prevention did not occur in all preventive-medicine consultations, despite the public-health implications of some parasites affecting small animals (Robertson et al., 2000). While this may highlight an opportunity to discuss parasite prevention more frequently in the veterinary consultation, it may be that these discussions also frequently occur during nurses' clinics or at the reception desk. Therefore, future research focusing on preventive medicine in first-opinion practice should involve veterinary nurses and reception staff, as opposed to veterinary surgeons only.

Multiple problems are not only frequently discussed during preventive-medicine consultations but are also often acted upon, suggesting these problems may be seen as important by the veterinary surgeon and/or pet owner. Not all problems discussed were acted upon, potentially highlighting a missed opportunity to maximise the health benefits of the consultation to the veterinary patient. This has been highlighted previously by Roshier and McBride (2013), who found that canine behavioural problems discussed during vaccination consultations were not fully explored or managed. However, it should be remembered that monitoring alone may be justified for some conditions, and the usefulness of 'watchful waiting' is being increasingly recognised in human healthcare (McCormick et al., 2005; Kendall and Murray, 2006; Holmberg et al., 2012), so acting upon all problems discussed

may be unnecessary. It has previously been suggested that early detection of disease during preventive-medicine consultations is likely to have a positive impact on patient care, as it provides the opportunity for earlier intervention (Diez et al., 2015; Davies, 2012). However, given controversies surrounding overdiagnosis and overtreatment in human healthcare (Moynihan et al., 2012), care should be taken not to assume early diagnosis and intervention is beneficial until further evidence is available to support this. Further research is needed to understand whether detecting and managing underlying disease during the preventive-medicine consultation has a positive impact on lifelong patient care.

The use of a convenience sample of practices is a limitation of the study, and it is currently unclear how representative these practices are likely to be of all practices within the UK. The veterinary surgeons observed were similar to those responding to the 2014 RCVS Survey of the Veterinary Profession (Buzzeo et al., 2014) in terms of years qualified and proportion holding a certificate. However the attributes of a 'typical' UK veterinary practice are currently unknown, and it is likely that there are many different types of veterinary practice conducting small-animal work. The practices involved in this study were all independently-owned, and further work is needed to examine consultations in corporate practices, where the approach to preventive medicine may potentially be quite different. Only seven practices were included, due to the feasibility and practical issues surrounding studies of this nature. While practice did not remain in the model as an explanatory variable, it is still possible that an effect of practice may have been seen, had there been sufficient practices to allow veterinary surgeon to be clustered within practice in the multilevel model. Clustering only within veterinary surgeon, and not within practice, could have led to over-estimation of the significance of the explanatory variables retained within the final model. It remains unclear how much practice characteristics, such as practice policies and equipment, influence the decisions made by the veterinary surgeon during the consultation, and this is an area which warrants further research.

Another limitation of this study is that, while the direct-observation method can determine what happens during preventive-medicine consultations, it cannot explain why certain patterns were seen. It is currently unclear what motivates owners to present their pet for a preventive-medicine consultation primarily aimed at administering a vaccine, and so it is uncertain whether pet owners, and veterinary surgeons, will see the value in presenting patients for a general 'annual health check'. Future work could use qualitative methods such as focus groups and interviews to understand the owner and veterinary-surgeon expectations towards preventive-medicine consultations. This could lead to better understanding of how preventive-medicine consultations could be enhanced to maximise the potential health benefit to the patient, improve client satisfaction and expand the business opportunities for the practice.

An additional limitation is that the analyses conducted for the secondary aim did not account for the hierarchical nature of the data, meaning clustering of problems within patient, veterinary surgeon and practice could play a role in some of the differences identified. A low cut-off for significance was used to account for multiple testing and Bonferroni correction is generally considered to be highly conservative (Petrie and Sabin, 2009). While it is difficult to be certain without further, more complex analysis, the low cut-off used may have diminished some of the potential problems which could result from not accounting for clustering.

While the agreement achieved for the inter-rater reliability study was substantial or almost perfect for patient and consultation characteristics, there was less agreement for problem characteristics. At the point the inter-rater reliability study was conducted, the primary investigator had been using the tool for over a year, while the second researcher had not previously used the tool, and

had only a brief period to examine the associated definitions. This was not a concern for the current study, as one researcher collected all data during the main study period. However, for future studies, if multiple researchers were required to use the tool, a longer period of initial training in use of the tool and associated definitions should be conducted first, as well as a larger inter-rater reliability study. Given the space constraints in most first-opinion consultation rooms, video-recording of consultations as opposed to real-time observation may be a more feasible method of conducting such a study.

## 5. Conclusions

Preventive-medicine consultations account for a considerable proportion of the veterinary caseload, and this is the first time that the complexity of these consultations has been examined in detail. Preventive-medicine consultations appear to be different to specific health-problem consultations in terms of patients presented, clinical examinations performed, and number and types of problems discussed. While there are controversies surrounding the value of preventive-medicine consultations (particularly in relation to vaccinations), the differences found suggest these consultations may be an opportunity to address aspects of veterinary care which may not be addressed in specific health-problem consultations. A greater evidence base is needed to determine whether these consultations, and the various aspects of patient health addressed within them, lead to positive long-term outcomes for the patient.

## Conflicts of interest

None.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.prevetmed.2015.12.010>.

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